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ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

Effectiveness of Systemic Insecticides Against the Pine Tip Moth on Ponderosa Pine[1]

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Carbofuran 10 percent granules and phorate 15 percent granules (10 pounds active ingredient per acre) were superior for protection of nursery stock against the pine tip moth, *Rhyacionia bushnelli*. At 2 ounces per inch of trunk diameter incorporated into the soil at the base of trees, they reduced infestations in ornamental and windbreak trees. Carbofuran wettable powder (0.25 %) or dimethoate emulsifiable concentrate (0.125 %) sprays performed well in nurseries and plantings. Timing of dimethoate applications is critical.

Keywords: Systemic insecticides, *Rhyacionia bushnelli, Pinus ponderosa.*

The pine tip moth, *Rhyacionia bushnelli* Busck (Lepidoptera: Olethreutidae), is an important insect pest of several species of pines in tree nurseries, Christmas tree plantations, and ornamental, field, and farmstead plantings. Tips injured by the larvae are unsightly, and tree growth is severely stunted (fig. 1). Damage has been severe enough to discourage planting of ponderosa pine, a highly desirable tree species in windbreaks.

Residual contact insecticides have not always provided adequate protection from tip moth

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Figure 1.—Many years of repeated tip killing by the western pine tip moth has badly deformed and stunted this ponderosa pine.

damage. Several treatments each season, carefully timed with the susceptible stages of the pest, were necessary to protect trees. Effective systemic insecticides would provide a longer period of protection so that exact timing of insecticide application would not be essential.

Our earlier study[4] indicated that an application of phorate granules to the soil in the spring protected young ponderosa pine trees in a shelterbelt for two growing seasons. However, a dimethoate spray was effective against only the first generation. The study reported here was conducted to evaluate additional systemics applied to the soil and to the foliage to reduce damage by the pine tip moth on nursery stock, and shelterbelt and ornamental trees.

[4]*Van Haverbeke, David. F., Robert E. Roselle, and Gary D. Sexson. 1971. Western pine moth reduced in ponderosa pine shelterbelts by systemic insecticides. USDA For. Serv. Res. Note RM-194, 8 p. Rocky Mt. For. and Range Exp. Stn., Ft. Collins, Colo.*

Methods and Materials

In 1969 and 1970, systemics applied as granules and as sprays were tested at the Bessey Nursery, Nebraska National Forest, at Halsey. Plots, 5 by 20 ft, were laid out in nursery beds containing 4-year-old stock. Each treatment was replicated four times in a randomized block design.

Granular systemics were applied in a 6-inch bank along each side and through the center of the nursery beds (fig. 2) and worked into the soil with a garden rake. The treated and untreated plots were then sprinkler irrigated. In 1959 phorate[5] and carbofuran were applied at the rate of 10 pounds active ingredient (AI) per acre on April 30 and again on July 5. In 1970, these and aldicarb and disulfoton were applied only once at rates of 2.5, 5, and 10 pounds AI per acre on April 25.

[5]*Common and chemical names of insecticides used are listed at the end of this Note.*

Figure 2.—Insecticide applicator, fabricated from tw
front bicycle forks, two bicycle wheels, and a Nobl
metering device, delivered granules through
garden hose to the soil surface in a 6-inch-wid
band.

Foliar sprays were applied with a knapsack sprayer at a rate of one-half gallon of emulsified chemical per 100 ft². The sprays were applied on May 16, and all but two plots were re-treated on June 30. One plot each of dimethoate and carbofuran was not re-treated so that we could determine if one application of these sprays would be sufficient to protect the trees against both generations of tip moth.

Granular systemics were applied in windbreak plantings in December 1969 to determine if early winter applications would provide protection from the tip moth the following season. Carbofuran 10% and phorate 15% were applied at the rate of 2 ounces of formulation per inch of trunk diameter (measured 12 inches above soil surface) in small holes about 6 inches deep at four locations around the drip line. Treatments were applied to 10-tree plots of 9-year-old trees at North Platte, where the treatments were replicated three times in a randomized block design. At Lincoln, the treatments were applied to 10-tree plots of 1-year-old and 6-year-old trees; treatments were replicated three and four times, respectively.

In 1970, tests to determine the effective rates of several granular systemic compounds were installed in windbreak plantings at Greenwood and North Platte. Phorate, aldicarb, and carbofuran were applied April 18 at North Platte, and these plus disulfoton on April 30 at Greenwood. The insecticides, at rates of 0.5, 1, and 2 ounces of formulation per inch of trunk diameter, were incorporated into the soil between the trunk and drip line with a garden rake. Untreated check plots were also established. The treatments were applied to 10-tree plots replicated four times in a randomized block design.

Also in 1970, several foliar sprays were tested on 9-year-old trees at North Platte, and 6-year-old trees at Lincoln. The treatments were applied to 5-tree plots randomly selected in windbreak plantings; each treatment was replicated three times. All sprays were applied with a knapsack sprayer, and each tree was sprayed to the point of runoff.

At North Platte the following foliar spray treatments were applied on May 16 and again on June 30: dimethoate, 0.125%; endosulfan, 0.25%; carbofuran, 0.25%; ENT 27567, 0.125%; and BAY 77488, 0.093%. These treatments and Baygon 0.125%, and BAY 44646, 0.332%, were applied to plots at Lincoln on May 23 and again on July 30. At North Platte, granular phorate was applied for comparison with the sprays on April 10 at the rate of 2 ounces of 15% granules per inch of trunk diameter. It was worked into the soil surface around the tree from the base to the drip line.

Results

In 1969, treatments of ponderosa pine in nursery beds with carbofuran 10% granules and phorate 15% granules (at 10 lb. AI per acre) reduced the percent of lateral and terminal tips infested by the tip moth better than the other materials tested (table 1). Dimethoate spray

Table 1.--Average percent[1] infestation of lateral and terminal tips of ponderosa pine nursery stock treated with systemic insecticides, Bessey Nursery, Halsey, Nebraska, 1969 and 1970

Treatment	Application rate	Percent infested tips per plot
1969--		
Carbofuran 10%	10 lb AI/acre	0.02 a
Phorate 15%	10 lb AI/acre	.03 a
Dimethoate 0.125%	.5 gal/100 ft²	.26 ab
Oxydemetonmethyl 0.25%	.5 gal/100 ft²	.92 bc
DDT 0.25%	.5 gal/100 ft²	1.39 cd
No insecticide		2.17 d
1970--		
Carbofuran 0.25%	.5 gal/100 ft²	0.1 a
Carbofuran 0.25%[2]	.5 gal/100 ft²	.1 ab
Carbofuran 10%	10 lb AI/acre	.6 abc
Dimethoate 0.125%	.5 gal/100 ft²	.7 abc
BAY 44646 0.332%	.5 gal/100 ft²	.8 abc
Aldicarb 10%	10 lb AI/acre	.9 abcd
Aldicarb 10%	5 lb AI/acre	1.4 cdefgh
Aldicarb 10%	2.5 lb AI/acre	2.6 jk
Carbofuran 10%	5 lb AI/acre	1.2 cdef
ENT 27567 0.125%	.5 gal/100 ft²	1.2 cdefg
Endosulfan 0.25%	.5 gal/100 ft²	1.7 defghi
Phorate 15%	10 lb AI/acre	1.7 efghi
Phorate 15%	5 lb AI/acre	1.7 efghi
Phorate 15%	2.5 lb AI/acre	2.2 hij
Carbofuran 10%	2.5 lb AI/acre	2.0 fghij
Dimethoate 0.125%[2]	.5 gal/100 ft²	2.1 ghij
Baygon 0.125%	.5 gal/100 ft²	2.4 ij
Disulfoton 15%	10 lb AI/acre	3.2 kl
Disulfoton 15%	5 lb AI/acre	3.3 kl
Disulfoton 15%	2.5 lb AI/acre	4.4 m
No insecticide		3.7 lm
BAY 77488	.5 gal/100 ft²	3.7 lm

[1]Percentages followed by a common letter are not significantly different at the 5 percent level of probability.

[2]Only one spray application.

was superior to DDT spray. Sprays of oxydemetonmethyl did not give better protection than DDT and they produced moderate phytotoxicity. In 1970, carbofuran WP gave the best protection against tip moth damage in the nursery (table 1). This formulation applied once was as effective as single applications of carbofuran and aldicarb 10% granules (at 10 lb. AI per acre) and two sprays of dimethoate, Bay 44646, and Diazinon. At Lincoln, carbofuran was more effective than phorate on 6-year-old trees, and both chemicals applied to 1-year-old trees reduced damage compared to no insecticide (table 2). At North Platte, however, neither material reduced damage significantly.

Table 2.--Average percent[1] infestation of lateral and terminal tips of ponderosa pine trees treated in December with granular systemic insecticides,[2] 1970

Treatment	North Platte	Lincoln	
	9-yr-old pines	1-yr-old pines	6-yr-old pines
Carbofuran 10%	47.3 a	37.2 a	31.0 a
Phorate 15%	48.4 a	53.3 a	54.2 b
No insecticide	62.8 a	79.1 b	59.5 b

[1]Percentages followed by a common letter are not significantly different at the 5 percent level of probability.

[2]Applied at the rate of 2 ounces formulation per inch of tree trunk diameter.

At North Platte, carbofuran 10% at 1 or 2 ounces and phorate 15% at 2 ounces per inch of trunk diameter provided the best reduction of tip moth damage (table 3). Aldicarb and disulfoton gave little or no protection.

In the tests of foliar sprays at North Platte and Lincoln, carbofuran WP, ENT 27567, endosulfan, and dimethoate gave generally good results (table 4). BAY 77488, BAY 44646, and Baygon were somewhat less effective.

Trees treated with granules or foliar sprays did not consistently produce average new growth greater than in untreated plots in any test.

Table 3.--Average percent[1] infestation of lateral and terminal tips of ponderosa pine trees treated with granular systemic insecticides, 1970

Treatment	Ounces/inch of trunk diameter	Percent infested tips per plot	
		Greenwood	North Platte
Carbofuran 10%	2	28.9 a	13.5 a
Carbofuran 10%	1	42.6 ab	16.8 a
Carbofuran 10%	0.5	45.4 ab	26.6 ab
Phorate 15%	2	40.7 ab	13.9 a
Phorate 15%	1	47.4 abc	18.8 ab
Phorate 15%	.5	53.8 bcd	31.3 ab
Aldicarb 10%	2	59.8 bcd	20.3 ab
Aldicarb 10%	1	68.7 cde	30.9 ab
Aldicarb 10%	.5	74.9 de	36.1 b
Disulfoton 15%	2	72.4 de	--
Disulfoton 15%	1	72.5 de	--
Disulfoton 15%	.5	85.1 e	--
No insecticide		73.5 de	73.3 c

[1]Percentages followed by a common letter are not significantly different at the 5 percent level of probability.

Table 4.--Average percent[1] infestation of lateral and terminal tips of ponderosa pine trees treated with foliar emulsifiable systemic insecticides, 1970

Treatment	Percent infested tips per plot	
	North Platte	Lincoln
Phorate 15%[2]	5.9 a	--
Carbofuran WP 0.250%	6.7 a	7.4 a
Endosulfan 0.250%	24.2 bc	7.2 a
ENT 27567 0.125%	7.5 a	7.4 a
Dimethoate 0.125%	16.2 ab	8.0 a
BAY 77488 0.093%	32.2 c	10.4 ab
Baygon 0.125%	--	15.2 b
BAY 44646 0.332%	--	15.4 b
No insecticide	69.9 d	46.0 c

[1]Percentages followed by a common letter are not significantly different at the 5 percent level of probability.

[2]Applied at the rate of 2 ounces of granular formulation per inch of trunk diameter.

Conclusions

Although systemic insecticides can greatly reduce tip moth damage, the most effective systemics are not registered for this use (only dimethoate, among those tested, is currently registered for control of pine tip moth). Therefore, most of the following conclusions cannot now be construed to be recommendations for use. Because pesticide registrations are under constant review by the U.S. Department of Agriculture, consult your county agricultural agent or State extension specialist before using any insecticide.

Ponderosa pine stock in tree nurseries can be protected with carbofuran 10% granules or phorate 15% granules applied in the soil between tree trunk and drip line at the rate of 2 ran WP 0.25% spray applied twice during the season. Dimethoate 0.125% spray applied twice, at the beginning of egg deposition, would also give satisfactory performance. Infestations in individual ornamental or windbreak trees can be reduced with carbofuran 10% granules or phorate 15% granules applied in the soil between tree and trunk drip line at the rate of 2 ounces per inch of trunk diameter. The insecticide should be applied by April 15.

The most effective registered insecticide to protect pine trees in field and farmstead windbreaks is dimethoate spray applied about mid-May and again the first of July. Satisfactory performance of dimethoate requires critical timing of the applications to coincide with egg deposition. Eggs of the first brood are deposited from mid-May until mid-June, and eggs of the second brood from late June until late July. More effective control would be obtained by spraying four times: the third week of May, the first week of June, in early July, and in mid-July.

Insecticides evaluated for protection of ponderosa pine trees and nursery stock in field test in Nebraska, 1969-70

Common names	Chemical names
Aldicarb	2 methyl-2-(methylthio)propionaldehyde O-methylcarbamoyl oxime
BAY 44646	4-dimethylamino-m-tolylmethylcarbamate
BAY 77488	phenylglyoxylonitrile exime O, O-diethyl phosphorothiate
Baygon (propoxur)	O-isopropoxyphenylmethylcarbamate
Carbofuran	2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate
DDT	1,1,1-trichloro-2,2-bis=(p-chlorophenyl)ethane
Diazinon	0,0-diethyl 0-(2-isopropyl-4-methyl-6-pyrimidyl) phosphorothiate
Dimethoate	0,0-dimethyl S-(N-methylcarbamoylmethyl) phosphorodithioate
Disulfoton	0,0-diethyl S-2 phosphorodithioate
ENT 27567	N'-(4-chloro-O-toyl)-N,N-dimethylformamidine, hydrochloride
Endosulfan	6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxa=thiepin 3-oxide
Oxydemetonmethyl	S- 0,0-dimethyl phosphorothioate
Phorate	O-O-diethyl-S phosphorodithioate

PESTICIDE PRECAUTIONARY STATEMENT

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key — out of the reach of children and animals — and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State extension specialist to be sure the intended use is still registered.

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